

Using a Lag Schedule to Increase Variability of Verbal Responding in an Individual With Autism

Carrie Susa, California Unified Service Providers, L.L.C, California State University, Los Angeles

Henry D. Schlinger, Jr., California State University, Los Angeles

Research has shown that reinforcing novel behaviors can increase the number of different ways that an individual behaves (Goetz & Baer, 1973; Pryor, Haag, & O'Reilly, 1969). However, it was not until more recently that researchers began to consider *variability* to be a reinforceable operant in and of itself (Neuringer, 2002). More specifically, Neuringer suggested that variability can be taught using a Lag x schedule of reinforcement, in which x refers to the number of previous responses from which the current response must differ in order for reinforcement to occur (Page & Neuringer, 1985). The purpose of the present study was to extend one of the first studies of a Lag x schedule on verbal responses with human subjects (Lee, McComas, & Jawor, 2002), by increasing the lag criteria while attempting to address some of methodological limitations of the study. The participant was a 7-year-old male with autism. A changing criterion design was used and results showed that 3 novel responses were acquired and varied according to the lag schedule of reinforcement.

Key words: autism, intraverbal, lag schedule of reinforcement, variability

Individuals diagnosed with autistic disorder are characterized by impairments in social interactions and communication, and by repetitive and stereotyped behavior (American Psychiatric Association, 1994). Specifically, in the area of communication, individuals with autism tend to answer questions in a rote and repetitive manner, which can be stigmatizing and eventually “result in a failure to adapt” (Neuringer, 2002, p. 687). Typically developing individuals, on the other hand, engage in non-scripted verbal behaviors, and can provide a variety of answers to the same question. Such behavior has been termed *intraverbal* by Skinner (1957), who described the intraverbal relation as a response to a verbal stimulus that differs in form from the response. For example, upon hearing the question, “How are you?” an intraverbal response would be “fine.”

Though only one response form to some questions is correct (e.g., “What is your birthday?”), a majority of conversational questions should optimally yield a number of varied responses. When children with autism are asked conversational questions that result in one rote response, they can be viewed as undesirable conversational partners. This could deter others from initiating or maintaining conversation; and as a result, opportunities for social interactions could be limited.

Researchers have identified multiple ways to promote response variability. Studies have shown that extinction of high frequency responses will often induce variability of responses within the same response class (Duker & van Lent, 1991; Grow, Kelley, Roane, & Shillingsburg, 2008; Lalli, Zanolli, & Wohn, 1994). Another method used to increase response variability is to simply reinforce novel or varied responses. Page and Neuringer (1985) proposed a specific schedule of reinforcement to promote response variability, referred to as a Lag x schedule, in which x refers to the number of previous responses from which the current response must differ in order for reinforcement to occur. Basic research (Abreu-Rodrigues, Lattal, Dos Santos, & Matos, 2005; Grunow & Neuringer, 2002; Neuringer, 1993; Schwartz, 1980) has demonstrated that response variability can be acquired

This study was carried out by the first author under the supervision of the second author in partial fulfillment of the requirements for the master of science in Psychology at California State University, Los Angeles. Address correspondence to Henry D. Schlinger, Jr., Department of Psychology, California State University, Los Angeles, 5151 State University Dr., Los Angeles, CA, 90032-8227. (e-mail: hschlin@calstatela.edu).

when novel responses (i.e., responses that vary from previous responses) are reinforced.

More recently, the Lag x schedule has been used in applied behavior analysis, specifically in the context of reinforcing varied verbal behavior in human participants (Esch, Esch, & Love, 2009; Lee, McComas, & Jawor, 2002). For example, Lee et al. (2002) used a Lag 1 schedule to increase response variability for questions to which the participants always responded with one specific response. All participants had a diagnosis of autism. The target question for 2 of the participants was, "What do you like to do?" and for the third participant it was, "How are you?" During the study, the participants were required to vary responses to the identified target question according to a Lag 1 schedule of reinforcement (i.e., each response had to differ from the previous response). Two of the 3 participants' responses varied according to the schedule.

The purpose of the current study was to replicate and extend the Lee et al. (2002) study by increasing the number of responses required by the lag schedule. Additionally, this study attempted to address some of the methodological problems in the Lee study. For example, the Lee study used parental report to assess potential reinforcers so it was unclear to what extent the events actually functioned as reinforcers. The present study employed a behavioral method of assessing preference to increase the likelihood that the programmed consequences functioned as reinforcers. Additionally, the target question, "What do you like to do?" used for 2 of the participants in the Lee et al. study may have been inadvertently prompted by visual access to a number of preferred toys and activities in the training room. Therefore, the present study employed the use of the question, "How are you?" used with the third participant in the Lee et al. study, to avoid responses coming under the control of visual stimuli.

METHOD

Participant

Jack was a 7 year-old boy diagnosed with autism (DSM-IV: 299.00). Jack was recruited from the client base of a nonpublic agency that provided behavior analytic services to individuals with developmental disabilities.

The clinical director of the agency recommended Jack for participation based on a specific goal in his Individualized Education Plan targeting the acquisition of varied responses to previously learned social questions.

Over the course of an intensive applied behavior analytic program, Jack had acquired spontaneous mands in the form of requests for items, activities, information, and attention. Mands occurred throughout the day approximately 3 to 7 times per hour. He did not spontaneously engage in tact or intraverbal behavior, although he did engage in stereotypic vocalizations. Jack could tact over 200 items given a verbal prompt of "What is it?" Jack had acquired intraverbal responses to 33 social questions but his responses were static and unchanging over time (e.g., when asked "How are you?" he always responded with "I'm fine").

Setting

The training sessions took place in Jack's home, in either his bedroom or the living room. Both training rooms contained multiple visual and auditory stimuli; however, none that could inadvertently evoke the response that was being trained. Sessions varied in duration; however, they always consisted of 10 training trials. The first one, two, or three responses were unscored as they were a foundation to determine whether or not a response could vary from them (i.e., a response could only vary from two previous responses if two responses had already occurred). Two sessions were conducted per day, between 2 and 4 days a week. No sessions were conducted during the week of Christmas and only one session was conducted during New Year's week. The study consisted of a total of 27 sessions over the course of 8 weeks.

Reinforcers

Jack's guardian identified several items and activities that could potentially serve as reinforcers. The experimenter placed all of the items and pictures of the activities in front of Jack and invited him to select one. The selected item was used as a reinforcer for the session, unless the participant verbally

reported a preference change during the session. This method increased the likelihood that an effective reinforcer was used throughout the study.

Items identified during preference assessments were presented for responses that correctly met the lag criteria in effect. Additionally, brief social praise was paired with the delivery of the tangible or activity reinforcer (e.g., "Very nice!").

Procedure

The question chosen as the verbal discriminative stimulus (S^D) was "How are you?" The S^D remained the same throughout the study. Each response was coded based on the number of previous responses from which it varied. For example, every response could vary from zero previous responses (i.e., the participant repeated the previous response), one previous response (e.g., "I'm fine" and then "I'm good"), two previous responses (e.g., "I'm fine," "I'm good," and "I'm okay"), or three previous responses (e.g., "I'm fine," "I'm good," "I'm okay," and "I'm super"). Therefore, every response was coded as (0), (1), (2), or (3) and the mean of all trials in a given session was calculated in order to get the average number of previous responses from which the current response varied.

A response was considered to "vary" from previous responses if it was topographically different from the previous response, but was still relevant to the question. If the first response was "I'm fine," the second response of "fine" would not be considered to vary. Additionally, a response of "cow" would not have been correct because it would be unrelated to the question.

When a Lag 1 was in effect, reinforcers were available only for responses that varied from the previous response. When a Lag 2 was in effect, reinforcers were delivered for responses that varied from the two previous responses. When the Lag 3 condition was introduced, each response needed to vary from the three previous responses in order to meet the lag criterion.

During the initial baseline phase, the S^D was stated and no responses yielded tangible or social consequences. The first session of every lag phase incorporated brief echoic prompts for incorrect responses (responses

that did not meet the lag criterion in effect). For example, if Jack's response did not vary from the previous response, "I'm fine," the investigator provided a full echoic prompt, "I'm good," and faded that prompt over the course of the session. This prompting session was deemed necessary as Jack had never before responded to the question of, "How are you?" with any response other than, "I'm fine." Following the initial prompting session, all subsequent sessions employed a brief extinction period (approximately 3 s) following an incorrect response; no reinforcer was delivered, and the S^D was restated. This error-correction chain continued until Jack's intraverbal response accurately met the lag criterion. Error correction did not constitute a new trial. The mastery criterion was achieved when Jack's responses all varied from previous responses in accordance with the lag criteria in effect. When mastery was achieved using the current Lag x schedule of reinforcement, the next lag schedule was introduced. Sessions were discontinued when Jack was correctly varying between four responses (Lag 3).

Intertrial intervals lasted for no longer than 1 min. Jack either consumed the edible reinforcer, or manipulated a tangible reinforcer for 1 min. During the intertrial interval, the investigator did not interact with Jack except to request that tangible items be put away.

A second observer scored data for 33% of the sessions. The second observer was a trained behavioral technician at Jack's agency. Data collection specific to the study was explained in detail prior to sessions beginning. Mean interobserver agreement was 90% (range, 80% to 100%).

A changing criterion design was used to evaluate different lag schedules of reinforcement for producing varied responses to social questions.

RESULTS

Results showed that alternative intraverbal responses were acquired using brief echoic prompts, and that response variability was a result of the introduction of the lag schedule of reinforcement. When there was no criterion in effect, Jack provided the same intraverbal response each time the question

was asked. Following the introduction of each lag criterion, response variability increased as evidenced by the increase in the number of previous responses from which each response varied (Fig. 1).

These findings extend the Lee et al. study by showing that the participant acquired more than two responses and varied between them depending on which lag criterion was in effect. Specifically, prior to implementing the intervention, Jack always responded to "How are you?" with the answer, "Fine." By the end of the study, Jack was alternating between "Fine," "Good," "Okay," and "Super."

DISCUSSION

Many children with autism do not spontaneously answer social questions with sufficient variability and may need to be specifically taught to vary their responses. The results of the present study showed that the use of echoic prompts in accordance with a lag schedule of reinforcement was successful in teaching response variability to a child with autism. Therefore, specific programming may be required to teach responses to commonly asked questions such as "How are you?" Typically, this is carried out by prompting and reinforcing one response to the exclusion of others. As a result the child may never respond differently. As Donahoe and Palmer (1994) noted, "The effect of a sustained contingency of reinforcement is to strengthen the contingent response relative to other behavior. While the contingency is in effect, behavior may appear stereotypic" (p. 279). Employing a lag schedule of reinforcement is one way to reduce stereotypic responses.

One possible limitation was that the training question (S^D) was delivered only by the lead investigator. Jack was likely exposed to the S^D throughout the day by a variety of people. Thus, it is possible that response variability may have come under the stimulus control of the trainer rather than the relevant aspects of the social question. Future research could address this potential limitation by including multiple experimenters to reduce the likelihood that the presence of a particular person would gain stimulus control over variability of responses.

The question, "How are you?" is ubiquitous in everyday life and it is likely that the participant came in contact with the question following the study. It is unlikely that people differentially reinforced variability to "How are you?" specifically because that would require keeping track of responses across interactions. More specifically, variability might be extinguished as people in the natural environment reinforce the same response. Maintenance probes could be conducted to test the durability of the response once programmed lag schedules of reinforcement were no longer present.

There is very little available research on the use lag schedules of reinforcement for promoting variability in verbal behavior. Past research has focused predominantly on nonverbal behaviors of nonhumans (Abreu-Rodrigues et al., 2005; Grunow & Neuringer, 2002; Neuringer, 1993; Pryor et al., 1969; Schwartz, 1980). With few exceptions to date (Esch et al., 2009; Lee et al., 2002), the research with humans has also largely consisted of nonverbal behaviors (Goetz & Baer, 1973; Lalli et al., 1994). However, a lag schedule could ideally be used when teaching multiple verbal operants. Individuals with autism not only acquire stereotypic intraverbal responses, but they can also develop mands and tacts that do not vary in a way that makes them more effective speakers. If we prompt and reinforce only one mand frame such as "I want," it can become the only frame used. Typically developing speakers tend to use multiple mand styles such as "May I have," or "Will you give me," etc. Even if multiple frames are taught, one frame may be reinforced more often than others in the natural environment and all other frames may cease. Thus, future research should extend this study by exploring the use of lag schedules of reinforcement for promoting variable mand and tact responses. The growing body of research suggests that variability is a reinforceable dimension of behavior and we can develop teaching technologies that promote more socially fluid verbal behavior. As a result, some of the stigma associated with behavioral language intervention (e.g., produces stereotyped responding) might be attenuated.

A question such as "How are you?" is only asked a few times a day at most in the

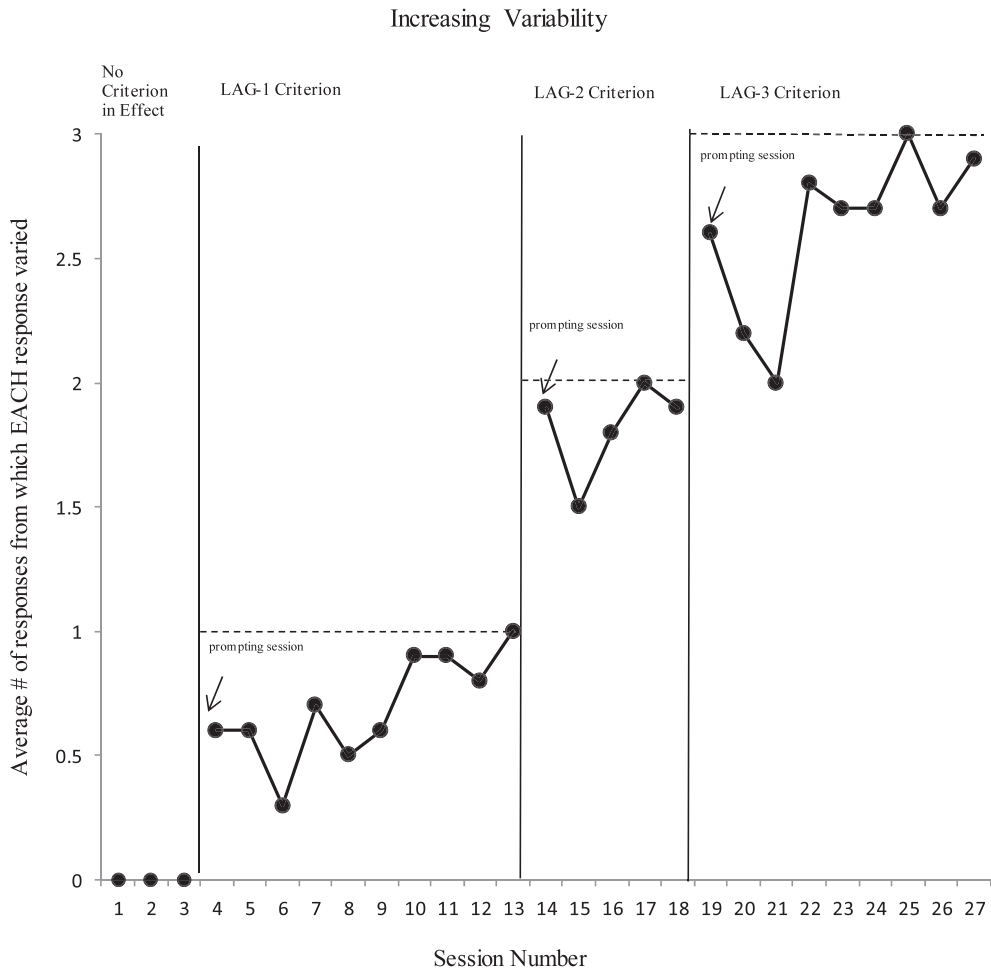


Figure 1. Changing Criterion: Averaging the trials across each session, this shows the number of previous responses from which each response varied. With the introduction of each new lag criterion, the average number of previous response increases.

natural environment (i.e., a lengthy “intertrial interval”). In the present study, intertrial intervals never exceeded 1 min. Future research might address this potential limitation by using lengthier intertrial intervals with social questions such as “How are you?” to mimic more naturalistic interactions in everyday life.

Despite the possible limitations, the results of our study showed that a lag schedule of reinforcement was successful in promoting variability in responding to a social question with one participant. Applied behavior analytic training programs are often criticized for teaching children to sound robotic with

stereotypic speech. The results of the present study suggest that schedules of reinforcement can be arranged to promote language that more closely approximates normal conversational skills.

REFERENCES

- Abreu-Rodrigues, J., Lattal, K.A., Dos Santos, C.V., & Matos, R. A. (2005). Variation, repetition, and choice. *Journal of the Experimental Analysis of Behavior*, 83, 147–168.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of*

- mental disorders* (4th ed.). Washington, DC: Author.
- Donahoe, J. W., & Palmer, D. C. (1994). *Learning and complex behavior*. Needham Heights, MA: Allyn and Bacon.
- Duker, P.C., & van Lent, C. (1991). Inducing variability in communicative gestures used by severely retarded individuals. *Journal of Applied Behavior Analysis*, 24, 379–386.
- Esch, J. W., Esch, B. E., & Love, J. R. (2009). Increasing vocal variability in children with autism using a lag schedule of reinforcement. *The Analysis of Verbal Behavior*, 25, 73–78.
- Goetz, E. M., & Baer, D. M. (1973). Social control of form diversity and emergence of new forms in children's blockbuilding. *Journal of Applied Behavior Analysis*, 6, 209–217.
- Grow, L. L., Kelley, M. E., Roane, H. S., & Shillingsburg, M. A. (2008). Utility of extinction-induced response variability for the selection of mands. *Journal of Applied Behavior Analysis*, 41, 15–24.
- Grunow, A., & Neuringer, A. (2002). Learning to vary and varying to learn. *Psychonomic Bulletin & Review*, 9, 250–258.
- Lalli, J. S., Zanolli, K., & Wohn, T. (1994). Using extinction to promote response variability in toy play. *Journal of Applied Behavior Analysis*, 27, 735–736.
- Lee, R., McComas, J. J., & Jawor, J. (2002). The effects of differential and lag reinforcement schedules on varied verbal responding by individuals with autism. *Journal of Applied Behavior Analysis*, 35, 391–402.
- Neuringer, A. (1993). Reinforced variation and selection. *Animal Learning and Behavior*, 21, 83–91.
- Neuringer, A. (2002). Operant variability: Evidence, functions, and theory. *Psychometric Bulletin & Review*, 9, 672–705.
- Page, S., & Neuringer, A. (1985). Variability is an operant. *Journal of Experimental Psychology: Animal Behavior Processes*, 11, 429–452.
- Pryor, K. W., Haag, R., & O'Reilly, J. (1969). The creative porpoise: Training for novel behavior. *Journal of Experimental Analysis of Behavior*, 12, 653–661.
- Schwartz, B. (1980). Development of complex stereotyped behaviors in pigeons. *Journal of the Experimental Analysis of Behavior*, 33, 153–166.
- Skinner, B. F. (1957). *Verbal behavior*. Acton, MA: Copley.